WECC 2005 POWER SUPPLY ASSESSMENT

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Overview of 2005 Power Supply Assessment

- Assessment is a collaborative effort of the Reliability Subcommittee, WECC staff, and many other contributors.
- Draft Assessment available on WECC website - http://www.wecc.biz/documents/meetings/Joint/2005/June/PCC/Power_Supply_Report_06-01-05.pdf
- Slides from report by John Leland, chair of the Reliability Subcommittee
- More details regarding California input data
- More details regarding California results

SAM Model

- Supply Adequacy Model (SAM) developed by CEC staff
- WECC assessment used deterministic mode of the model
- Evaluates physical ability of interconnection to supply all load regardless of contractual obligations
- Computes a Power Supply Margin (PSM) not Reserve Margin

L&R Calculation

Reserve Margin = Resources + Imports – Exports – Load

Surplus/Deficiency = Resources + Imports – Exports – (Load + Reserve Margin)

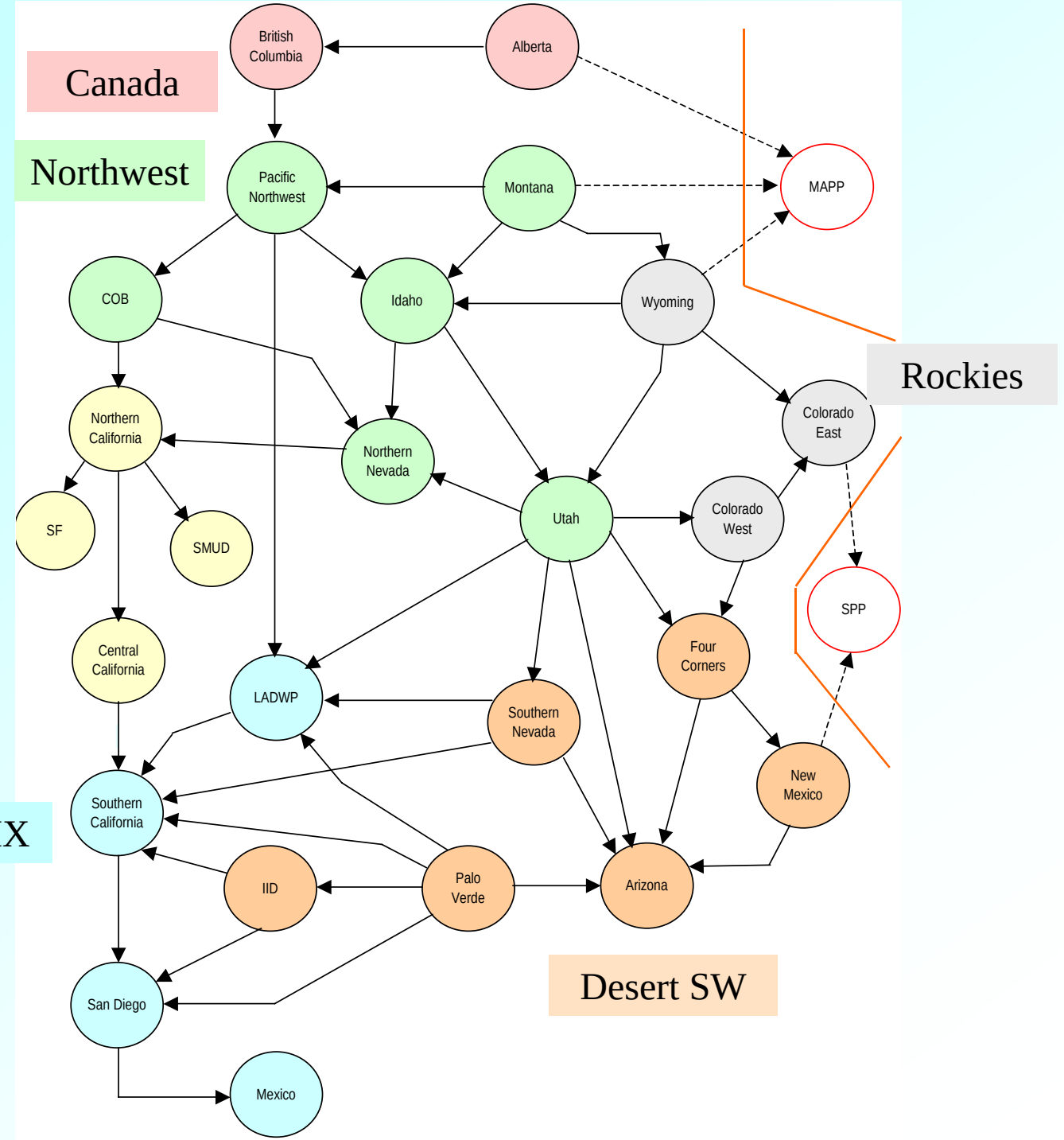
SAM Calculation

PSM = Resources – (Load + Reserve Margin) + (Imports – Exports)

Imports and/or Exports = Calculated in SAM Solution

Blue = input data

SAM Topology



SAM Inputs and Calculations

- Data supplied by WECC members
- Loads & Resources (L&R) Data
  - 10 years of monthly load forecast data
  - Existing generation capacities
  - Near-term generation additions and retirements
  - Generation outage forecasts
- Zone to zone transmission transfer capability forecast
- Load temperature sensitivity

- Data organized into zones – loads, resources, transfer capabilities. Adjusted Data exported to SAM.
- SAM calculations done at zone level, but results are reported at sub-region level to maintain confidentiality.

Aggregation of Zones to Sub-regions

Sub-Region	Zones in Sub-Region
Canada	Alberta, British Columbia
Northwest	COB, Idaho, Montana, No. Nevada, Pacific Northwest, Utah
Rockies	Colorado-East, Colorado-West, Wyoming
Desert SW	Arizona, IID, Four Corners, New Mexico, Palo Verde, So. Nevada
No. CA	Central CA, Northern CA, San Francisco, SMUD
So. CA/MX	CFE-Mexico, Southern CA, San Diego, LADWP

Six Scenarios

Differences Between Scenarios

	Scenarios					
	1	2	3	4	5	6
Reserve Margin	PSDC	PSDC	PSDC	PSDC	15%	15%
Season	Summer July	Summer July	Winter December	Winter December	Summer July	Summer July
Temperature Deviation	No	+5	No	-10	No	No
Uncommitted Generation	No	No	No	No	No	Yes

PSDC = Power Supply Design Criteria applied

Power Supply Design Criteria

	Criteria	Minimum Design Performance
1.	Monthly Reserve Capacity After Deducting Scheduled Maintenance (MW)	Greater of R, or the largest Risk plus 5 percent of Load Responsibility
2.	Monthly Reserve Capacity After Deducting Scheduled Maintenance	2 largest Risks
3.	Annual reliability criterion based on probability of loss of load, either a. Frequency of loss of load or, b. Probability of meeting all loads in a year	 One day in ten years 0.90

$$R = \frac{(.05H + .15T)}{H + T} \times L$$

H = Monthly hydro capability after deducting scheduled maintenance

T = Monthly non-hydro generating capability after deducting scheduled Maintenance

L = Load Responsibility

>> This assessment assumed that the smaller of Criteria 1 or 2 must be met.

>> Criteria 3 requires probabilistic information not available.

>> The largest risk considered only generation not other risks such as transmission.

>> Reserve sharing group benefits were not captured in this analysis.

Power Supply Design Criteria

EXAMPLE - - -

Zone	Scenario 1a 5% hydro 15% thermal resource reduction	Scenario 1b Largest risk plus 5% load escalation	Scenario 2 2 largest risks	PSDC Reserve
Zone 1	500	525	1100	525
Zone 2	210	200	900	210
Zone 3	340	310	300	300
Total	1050	1035	2300	1035

Canada
Northwest
Rockies
DSW
No. Cal
So. Cal/MX

Greater of

Lesser of

Calculated Reserve Margins Assumed

Scenarios 1-4 (PSDC)

Summer Reserve

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Canada	10.5%	10.4%	10.9%	10.6%	10.5%	10.3%	10.1%	9.9%	9.8%	9.6%
Northwest	11.3%	11.1%	10.9%	10.8%	10.7%	10.6%	10.5%	10.3%	10.1%	9.9%
Rockies	15.2%	14.8%	14.5%	14.1%	13.8%	16.5%	16.1%	15.8%	15.4%	15.0%
Desert SW	10.8%	9.3%	9.0%	8.8%	8.5%	8.2%	8.0%	7.8%	7.6%	7.4%
No. CA	13.6%	13.7%	13.4%	13.1%	12.8%	12.5%	12.3%	12.0%	11.7%	11.5%
So CA/MX	11.8%	11.6%	11.3%	11.1%	10.8%	10.6%	10.4%	10.2%	10.0%	9.8%
WECC	11.9%	11.5%	11.3%	11.1%	10.9%	10.9%	10.7%	10.5%	10.3%	10.1%

Winter Reserve

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Canada	9.3%	9.2%	9.0%	8.8%	8.7%	8.5%	8.4%	8.2%	8.1%	8.0%
Northwest	9.9%	9.7%	9.6%	9.5%	9.3%	9.2%	9.1%	9.0%	8.9%	8.8%
Rockies	17.6%	17.2%	16.8%	16.5%	16.1%	18.7%	18.6%	18.4%	18.2%	17.8%
Desert SW	15.7%	13.6%	13.2%	12.9%	12.6%	12.3%	12.0%	11.7%	11.5%	11.5%
No. CA	18.8%	18.4%	17.9%	17.5%	17.1%	16.8%	16.4%	16.1%	15.8%	15.5%
So CA/MX	15.0%	14.8%	14.5%	14.2%	13.9%	13.7%	13.4%	13.2%	13.0%	12.7%
WECC	13.4%	12.9%	12.7%	12.4%	12.2%	12.2%	12.0%	11.8%	11.7%	11.5%

Scenarios 5-6

All zones 15%

Summary Results
Year of First Deficit and Deficit Zone Ratio

Sub-Region	Scenario					
	1	2	3	4	5	6
Canada			2012 1:2	2008 1:2		
Northwest					2013 3:6	
Rockies	2009 1:3	2009 1:3			2009 2:3	2009 2:3
Desert Southwest	2010 1:6	2008 1:6			2008 1:6	2009 1:6
No. California	2013 1:4	2012 1:4			2010 1:4	2011 1:4
So. California/Mexico[1]	2009 1:4	2008 2:4			2008 2:4	2009 2:4

Deficit Zone Ratio is the ratio of the number of zones in the sub-region that are deficit out of the total number of zones in the sub-region. The deficit condition means that the sum of the power supply margins for the zones in the sub-region was negative.

Scenario #1 Power Supply Margin

Summer PSDC Results

Scenario #1		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer 1:2 Forecast PSDC	Canada	3,073	2,833	3,226	2,182	2,766	2,518	2,233	1,328	1,575	1,271
	Northwest	11,106	11,247	11,622	9,478	5,085	3,629	2,952	2,791	1,453	636
	Rockies	996	626	86	0	-20	-278	-545	-1,262	-1,544	-1,879
	Desert SW	2,017	2,422	84	0	0	-318	-432	-761	-1,619	-2,428
	No. CA	0	0	0	0	0	0	0	0	-612	-1,311
	So. CA/MX	717	800	162	41	-79	-2,289	-4,648	-6,314	-7,421	-8,486
	Total	17,908	17,928	15,179	11,701	7,751	3,262	-440	-4,218	-8,168	-12,197

Criteria Met	Positive = Excess generation not needed by other sub-regions or stranded by transmission constraints.
	Zero = Transfers involved
Criteria Not Met	Negative = Insufficient resources and/or imports

The aggregated results by sub-region are the sum of the power supply margins for the zones in the sub-region, and may not be indicative of the supply status for every zone in the sub-region. For example, when the So. CA/MX sub-region becomes deficit in 2009, only one of the four zones is actually deficit as the other three zones are able to import sufficient capacity to meet their load requirements. The table in the previous slide identifies the deficit ratio for each scenario and sub-region.

The projection of resource additions/retirements is limited to two or three years into the future and this directly impacts the results with fewer known additions after 2008. It is logical to expect that more projects will be built as they are needed and as older projects are retired. **At some point, the study results shift from a determination of supply margin to a determination of future needs.**

Scenario #1 & #2 Power Supply Margin

Summer PSDC Results

Scenario #1		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	3,073	2,833	3,226	2,182	2,766	2,518	2,233	1,328	1,575	1,271
1:2 Forecast	Northwest	11,106	11,247	11,622	9,478	5,085	3,629	2,952	2,791	1,453	636
PSDC	Rockies	996	626	86	0	-20	-278	-545	-1,262	-1,544	-1,879
	Desert SW	2,017	2,422	84	0	0	-318	-432	-761	-1,619	-2,428
	No. CA	0	0	0	0	0	0	0	0	-612	-1,311
	So. CA/MX	717	800	162	41	-79	-2,289	-4,648	-6,314	-7,421	-8,486
	Total	17,908	17,928	15,179	11,701	7,751	3,262	-440	-4,218	-8,168	-12,197

Scenario #2		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	3,073	2,833	3,226	2,182	2,064	2,518	1,581	1,876	1,575	1,271
+ 5 degrees	Northwest	10,513	11,253	8,149	6,533	5,787	3,629	3,604	2,243	1,453	636
PSDC	Rockies	417	117	0	0	-49	-701	-968	-1,262	-1,544	-1,879
	Desert SW	0	0	0	-343	-429	-964	-1,811	-2,572	-3,430	-4,251
	No. CA	0	0	0	0	0	0	0	-257	-938	-1,639
	So. CA/MX	292	183	68	-278	-3,034	-4,639	-6,271	-7,687	-8,724	-9,790
	Total	14,295	14,386	11,443	8,094	4,340	-157	-3,866	-7,659	-11,609	-15,652

Criteria Met	Positive = Excess generation not needed by other sub-regions or stranded by transmission constraints.
	Zero = Transfers involved
Criteria Not Met	Negative = Insufficient resources and/or imports

Scenario #5 Power Supply Margin

Summer 15% Margin Results

Scenario #5		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	2,595	2,319	2,678	2,285	2,091	1,681	1,349	931	579	227
1:2 Forecast	Northwest	9,874	9,950	6,320	4,403	3,327	2,325	1,573	764	-150	-1,087
15% Reserve	Rockies	390	49	0	0	-301	-846	-1,151	-1,487	-1,808	-2,191
	Desert SW	0	0	0	-409	-509	-1,343	-2,317	-3,198	-4,198	-5,142
	No. CA	0	0	0	0	0	-35	-683	-1,347	-2,025	-2,720
	So. CA/MX	471	351	225	-873	-3,448	-5,238	-6,451	-7,681	-8,943	-10,240
	Total	13,329	12,669	9,223	5,406	1,161	-3,456	-7,681	-12,018	-16,546	-21,153

Criteria Met	Positive = Excess generation not needed by other sub-regions or stranded by transmission constraints.
	Zero = Transfers involved
Criteria Not Met	Negative = Insufficient resources and/or imports

Scenario #5 & #6 Power Supply Margin

Summer 15% and 15% + Uncommitted Results

Scenario #5		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	2,595	2,319	2,678	2,285	2,091	1,681	1,349	931	579	227
1:2 Forecast	Northwest	9,874	9,950	6,320	4,403	3,327	2,325	1,573	764	-150	-1,087
15% Reserve	Rockies	390	49	0	0	-301	-846	-1,151	-1,487	-1,808	-2,191
	Desert SW	0	0	0	-409	-509	-1,343	-2,317	-3,198	-4,198	-5,142
	No. CA	0	0	0	0	0	-35	-683	-1,347	-2,025	-2,720
	So. CA/MX	471	351	225	-873	-3,448	-5,238	-6,451	-7,681	-8,943	-10,240
	Total	13,329	12,669	9,223	5,406	1,161	-3,456	-7,681	-12,018	-16,546	-21,153

Scenario #6		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	2,595	2,319	1,976	2,285	1,447	1,781	1,694	1,403	1,176	827
1:2 Forecast	Northwest	9,893	12,404	12,458	12,610	12,080	11,215	11,133	10,072	9,038	8,100
15% Reserve	Rockies	390	49	0	0	-115	0	-265	-737	-1,058	-1,441
Uncommitted	Desert SW	0	0	0	0	-465	-404	-618	-1,223	-1,992	-2,789
	No. CA	0	0	0	0	0	0	-6	-669	-1,344	-1,649
	So. CA/MX	471	351	943	1,056	-46	-1,910	-4,187	-5,118	-6,226	-7,352
	Total	13,348	15,123	15,377	15,951	12,902	10,681	7,751	3,728	-406	-4,304

Criteria Met	Positive = Excess generation not needed by other sub-regions or stranded by transmission constraints.
	Zero = Transfers involved
Criteria Not Met	Negative = Insufficient resources and/or imports

Scenario #1 & #5 Power Supply Margin

Summer: Scenario #1 and #5 Results

Scenario #1		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	3,073	2,833	3,226	2,182	2,766	2,518	2,233	1,328	1,575	1,271
1:2 Forecast	Northwest	11,106	11,247	11,622	9,478	5,085	3,629	2,952	2,791	1,453	636
PSDC	Rockies	996	626	86	0	-20	-278	-545	-1,262	-1,544	-1,879
	Desert SW	2,017	2,422	84	0	0	-318	-432	-761	-1,619	-2,428
	No. CA	0	0	0	0	0	0	0	0	-612	-1,311
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	Total	17,908	17,928	15,179	11,701	7,751	3,262	-440	-4,218	-8,168	-12,197

Scenario #5		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Summer	Canada	2,595	2,319	2,678	2,285	2,091	1,681	1,349	931	579	227
1:2 Forecast	Northwest	9,874	9,950	6,320	4,403	3,327	2,325	1,573	764	-150	-1,087
15% Reserve	Rockies	390	49	0	0	-301	-846	-1,151	-1,487	-1,808	-2,191
	Desert SW	0	0	0	-409	-509	-1,343	-2,317	-3,198	-4,198	-5,142
	No. CA	0	0	0	0	0	-35	-683	-1,347	-2,025	-2,720
	So. CA/MX	471	351	225	-873	-3,448	-5,238	-6,451	-7,681	-8,943	-10,240
	Total	13,329	12,669	9,223	5,406	1,161	-3,456	-7,681	-12,018	-16,546	-21,153

Criteria Met	Positive = Excess generation not needed by other sub-regions or stranded by transmission constraints.
	Zero = Transfers involved
Criteria Not Met	Negative = Insufficient resources and/or imports

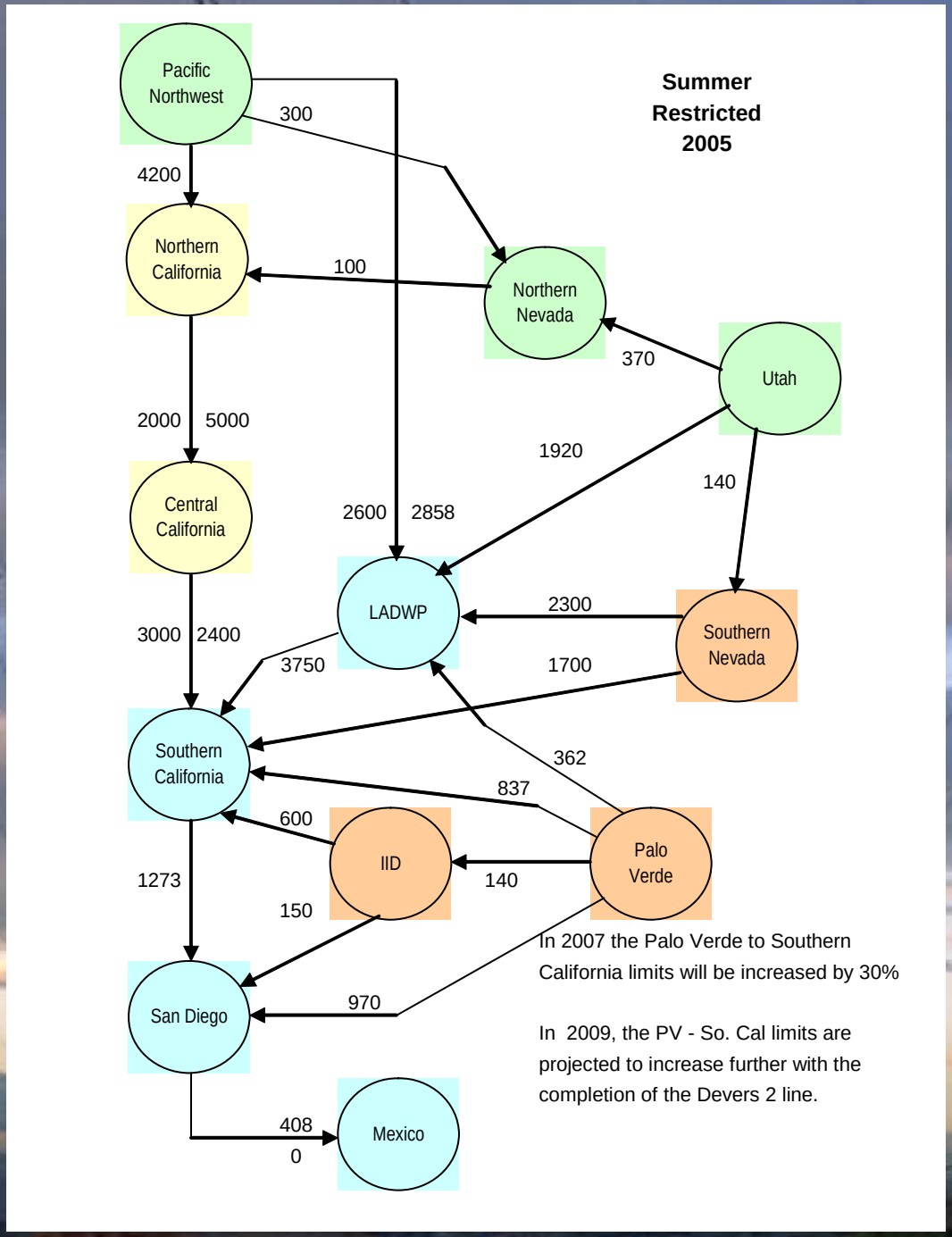
Conclusions from Assessment

- Summer
  - Capacity surplus in the Northwest
  - Load growth in the Southwest outpaces the development of known new generation resources
  - Transmission constraints consistently produced constrained paths along a cut-plane that has been called the "North-South Split"
  - Assumed reserve margins met until 2008
- Winter
  - Reserve margin met until 2011 with normal temperature
  - 2008 under "Severe" Temperatures

Assessment Results for California

Transfer capabilities between zones that impact California imports.

Values are de-rated from OTC ratings based on “limits that may reasonably be expected to apply under simultaneous high seasonal loading conditions”.



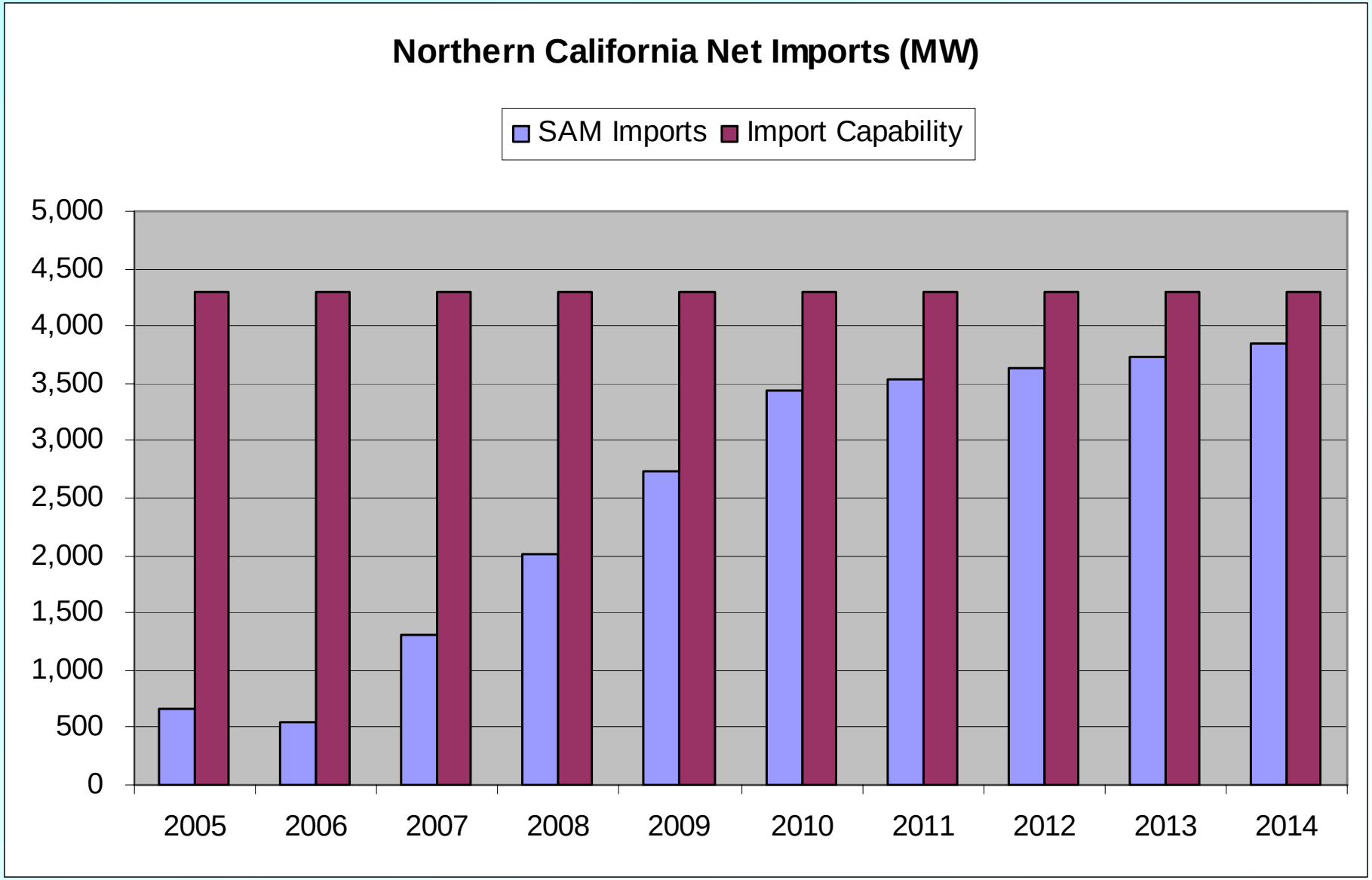
California Results

scenario assuming 15% reserves, July 1:2 load forecast, only committed resource additions

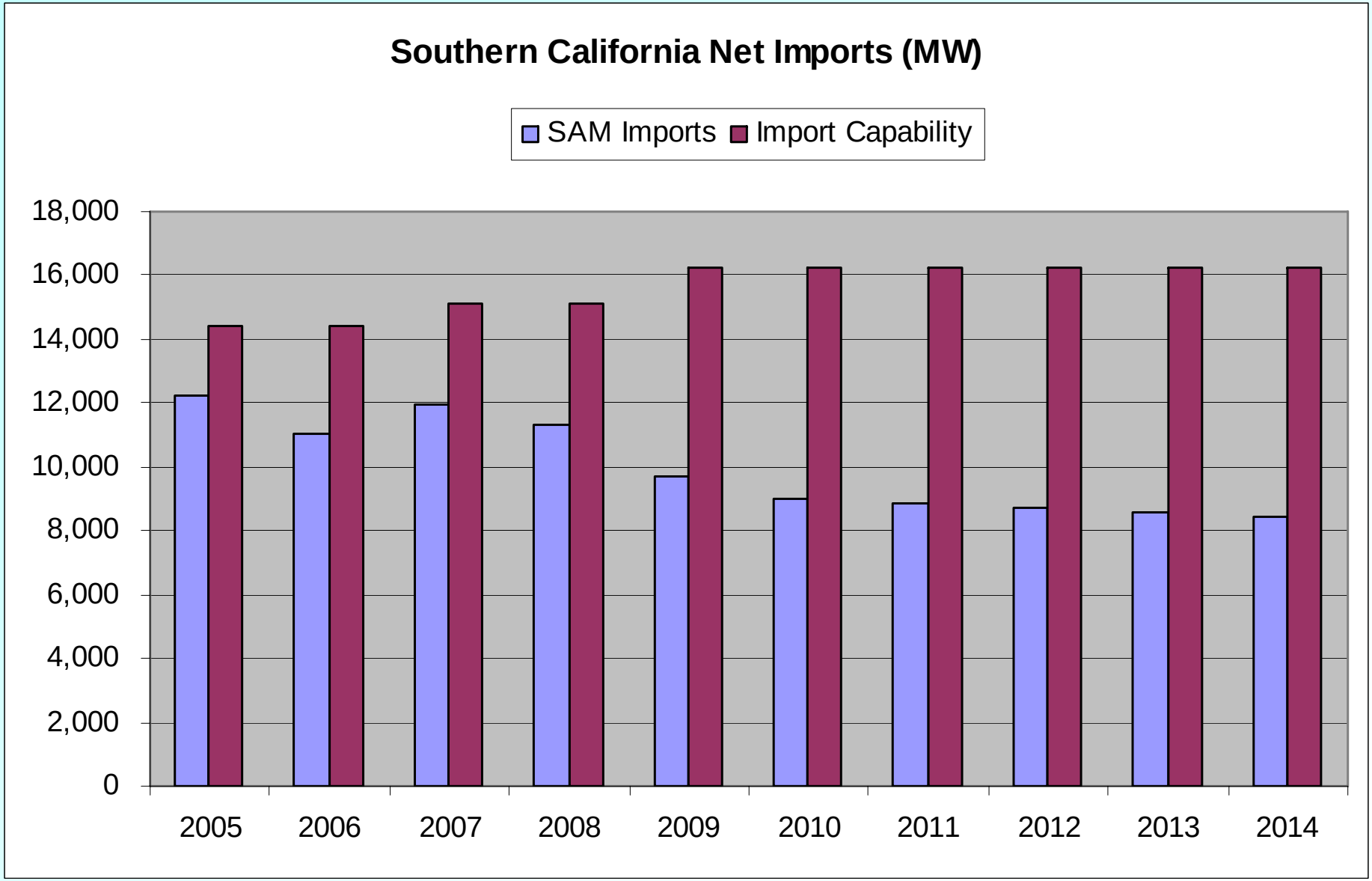
California/Mexico Sub-region Summary - Scenario #5

Parameter	15% Sub-region	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Firm Demand	No. CA	23,189	23,738	24,332	24,940	25,561	26,198	26,850	27,516	28,195	28,891
	So. CA/MX	32,755	33,557	34,426	35,313	36,214	37,149	38,094	39,052	40,034	41,045
Non-Firm Demand (zero if not applied)	No. CA	925	925	925	925	925	925	925	925	925	925
	So. CA/MX	885	886	886	886	886	886	886	886	886	886
Assumed reserve margin	No. CA	3,617	3,699	3,789	3,880	3,973	4,068	4,166	4,266	4,368	4,472
	So. CA/MX	5,046	5,166	5,297	5,430	5,565	5,705	5,847	5,991	6,138	6,290
Load Requirement	No. CA	27,731	28,361	29,045	29,745	30,458	31,191	31,940	32,707	33,487	34,287
	So. CA/MX	38,686	39,609	40,608	41,628	42,665	43,739	44,827	45,928	47,058	48,220
Net Base Resource Capacity	No. CA	28,095	28,780	28,780	28,780	28,780	28,780	28,780	28,780	28,780	28,780
	So. CA/MX	28,216	30,029	30,029	30,619	30,619	30,619	30,619	30,619	30,619	30,619
Cumulative UnCommitted Additions	No. CA	0	0	0	0	0	0	0	0	0	0
	So. CA/MX	0	0	0	0	0	0	0	0	0	0
Other Outages and De-rates	No. CA	(1,019)	(970)	(1,043)	(1,056)	(1,057)	(1,057)	(1,053)	(1,051)	(1,051)	(1,051)
	So. CA/MX	(1,316)	(1,117)	(1,172)	(1,153)	(1,115)	(1,103)	(1,101)	(1,098)	(1,095)	(1,093)
Net Imports (+)	No. CA	655	551	1,308	2,021	2,734	3,432	3,530	3,631	3,733	3,839
	So. CA/MX	12,257	11,049	11,976	11,290	9,714	8,986	8,857	8,726	8,591	8,454
Available Resources	No. CA	27,731	28,361	29,045	29,745	30,458	31,156	31,257	31,360	31,462	31,568
	So. CA/MX	39,157	39,960	40,833	40,755	39,217	38,502	38,375	38,247	38,114	37,980
Power Supply Margin	No. CA	0	0	(0)	(0)	0	(35)	(683)	(1,347)	(2,025)	(2,720)
	So. CA/MX	471	351	225	(873)	(3,448)	(5,238)	(6,451)	(7,681)	(8,943)	(10,240)

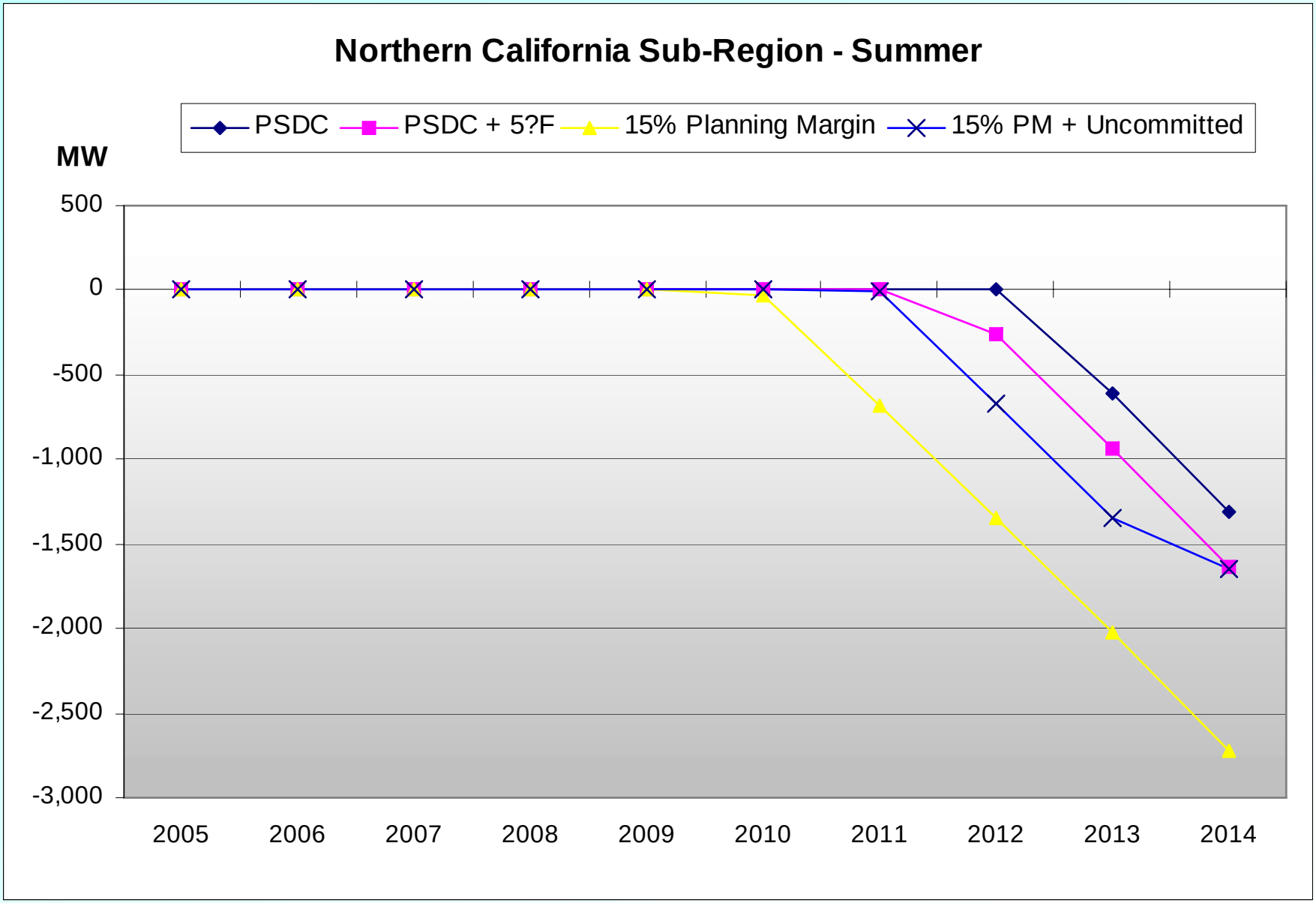
Power supply margin is equal to Available Resources minus Load Requirement. The positive power supply margin for So. CA/MX in 2005 – 2007 represents a “stranded” surplus in CFE (Mexico).

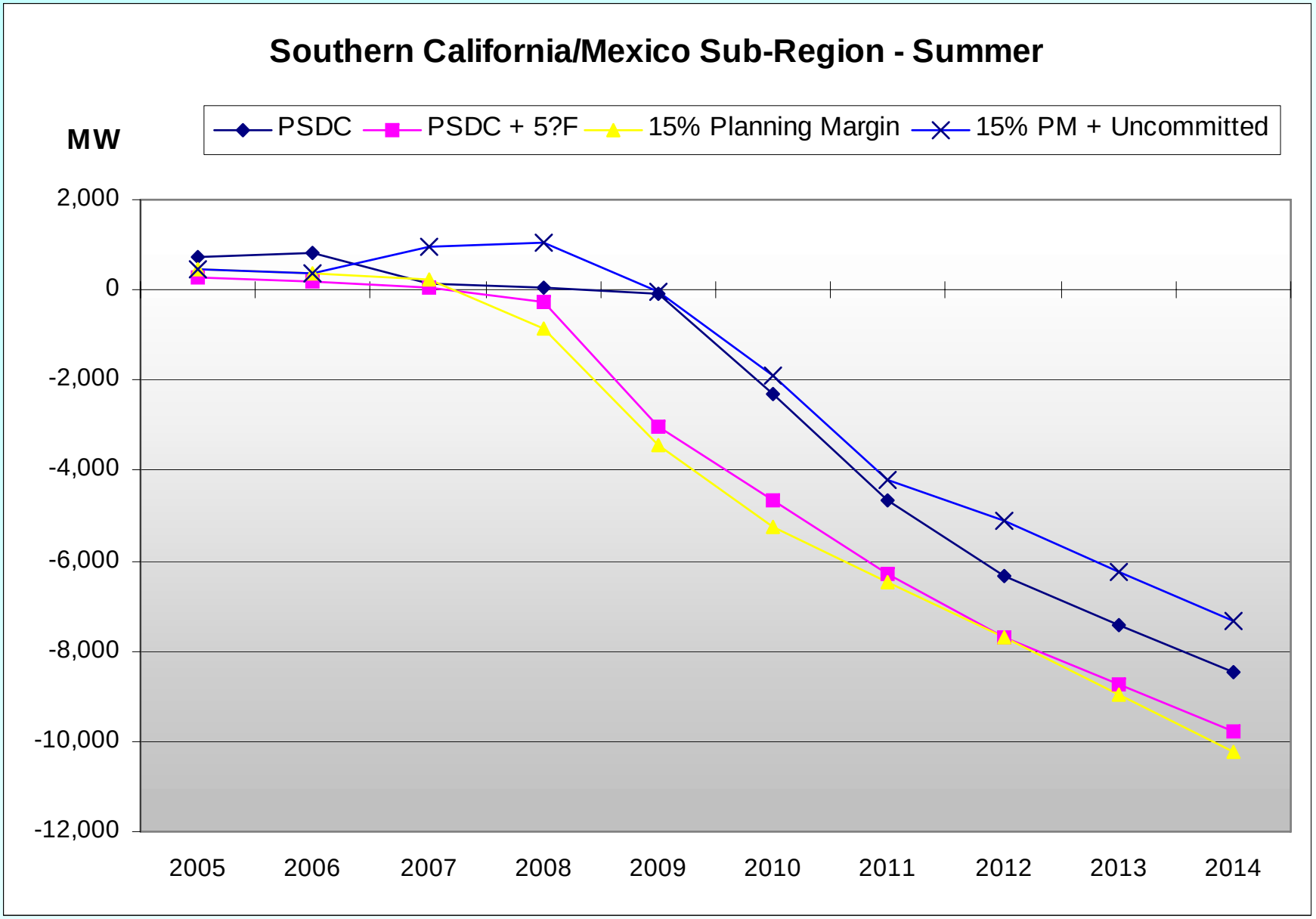


Scenario #5 Results



Scenario #5 Results


Northern California Sub-Region - Summer
PSDC
PSDC + 5?F
15% Planning Margin
15% PM + Uncommitted
MW
500
0
-500
-1,000
-1,500
-2,000
-2,500
-3,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Southern California/Mexico Sub-Region - Summer
MW
PSDC
PSDC + 5?F
15% Planning Margin
15% PM + Uncommitted
2,000
0
-2,000
-4,000
-6,000
-8,000
-10,000
-12,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


THE END